HYDROIDS (CNIDARIA, HYDROZOA) OF BAA ATOLL (INDIAN OCEAN, MALDIVES ARCHIPELAGO)

BY

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ABSTRACT

This study provides the first description of hydroid species and communities in Baa Atoll. 22 stations from 0 to 30 meters depth (except one at 50) were visited based on contrasted geomorphology, and 568 benthic specimens collected. Preliminary results provided a provisional list of 115 species, of which 100 are new records for the Maldives Archipelago. The hydroid fauna of Baa Atoll consists of 74% leptothecates and 26% antoathecates, and represents 26 families and 43 genera. Besides the Eudendriidae (7 spp), the most speciose families (>10 spp) were the Aglaopheniidae, Campanulariidae, Halopterididae, Haleciidae and Sertulariidae. Several new species are suspected but additional material and/or more taxonomic studies are required to complete the descriptions. The more common species are documented by underwater and laboratory photographs (29 spp), with a focus on aglaophenids. The species richness was high and well distributed in the varied locations visited. Richness was higher on atoll rim faro than inside the atoll. Richness was also higher on outer slopes and passes than reef flats and inner reefs of rim faro. The absence of *Aglaophenia cupressina* and of the fire corals *Millepora* was noticed. Combining records gathered from old literature data and those of this Baa Atoll study, the hydroid species richness in the Maldives reaches 160 spp, which is high like in other Indian Ocean islands.

INTRODUCTION

Only three scientific articles, published at the very beginning of the 20th century, concern the Maldives Archipelago Hydrozoa (Bigelow, 1904; Browne, 1904; Borradaile, 1905). Browne and Borradaile studied respectively specimens of medusae and polyps collected during the oceanographic expedition (1899-1900) of J. Stanley Gardiner who published “The Fauna and Geography of the Maldives and Laccadive Archipelagoes” in 1904. Bigelow studied medusae going from the steamer “Amra” expedition (1901-1902) related by Alexander Agassiz (1903). Hydroid colonies were mainly obtained by dredging. From a depth of 37-77 m (except for one littoral), Borradaile (1905) described 23 species of hydropolyps of the orders Anthoathecata and Leptothecata, including 7 new

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species. Medusae were taken off mainly by plankton surface hauls. Bigelow (1904) and Browne (1904) reported respectively 13 and 7 species of hydromedusae (Anthomedusae, Leptomedusae and Limnomedusae), with none in common among them, and none as well with Borradaile. In addition, these two authors reported a few species belonging to other hydrozoan groups with holoplanctonic life cycle (Trachymedusae, Narcomedusae and Siphonophores). These taxa are not taken into consideration in the present study that focuses on the benthic fauna.

This historical knowledge yields a list of 43 species for the orders Anthoathecata (12), Leptothecata (29) and Limnomedusa (2), 23 from polyps and 20 from jellyfishes. While no other dedicated research on the Maldives hydrozoans was done to our knowledge, scattered additional data have been found. The John Murray expedition in the Indian Ocean, which essentially concerned the deep waters, provided four additional species, including a new one (Rees & Vervoort, 1987). For the peculiar families having a calcareous skeleton, the Milleporidae and the Stylasteridae, data are found separately, as these families are usually studied together with calcareous hard corals. Boschma (1948) summarizing old knowledge on the milleporids reported the single species *Millepora platyphylla* Hemprich & Ehrenberg, 1834 in the Maldives, while more recent studies mentioned also branched species like *Millepora latifolia* Boschma, 1948 and *Millepora tenera* Boschma, 1948 (Wells & Davies, 1966 in Stoddart, 1966; Lewis, 2006). Regarding stylasterids, Broch (1947) reported two species of the genus *Crypthelia* from deep areas (200-900m), and Wells & Davies (1966) and Scheer & Obrist (1986) two other species from shallow waters, *Distichopora fisheri* Broch, 1942 and *Distichopora nitida* Verrill 1864, respectively. Finally, marine life identification books on Maldives fauna and flora include imprecise data but good photographs of hydrozoans (Anderson, 1991; Coleman, 2000). This review indicates that the known species richness in the Maldives was 60 prior to this study (38.3% anthoathecates, 58.3% leptothecates, and 3.3% limnomedusae, with 18 species known as a medusa only), a low number in respect to the wide marine area covered by Maldivian reefs.

During a biodiversity survey carried out in 2009 in Baa Atoll (center West of the Maldives Archipelago), an inventory of the hydroid fauna was done to update knowledge on marine biodiversity of the Man and Biosphere UNESCO Reserve of Baa Atoll (Jimenez et al, submitted). The results are presented here with the aims to (1) quantify species richness, (2) establish a preliminary list of species, (3) analyze the composition of the hydroid fauna, and (4) provide photographs for the macroscopic species most easily seen while scuba-diving, with a focus on the family Aglaopheniidae. This is the first extensive study of benthic hydroids conducted in the Maldives Archipelago.

MATERIAL AND METHODS

From 23rd May to 5th June 2009, a collection of hydroids was made in shallow waters around Baa Atoll from the boat NOAH, at the beginning of the Southwest monsoon. Baa Atoll, circa 40 km long and wide, has a discontinuous rim. It is located in the western side of the Maldives Archipelago at 5° 11′ N and 72° 59′ E (Fig. 1). Twenty-

two stations were sampled for benthic hydroids, 21 of which between 0 and 30 meters in depth and one (Station 23) at 50 m (Fig. 1).

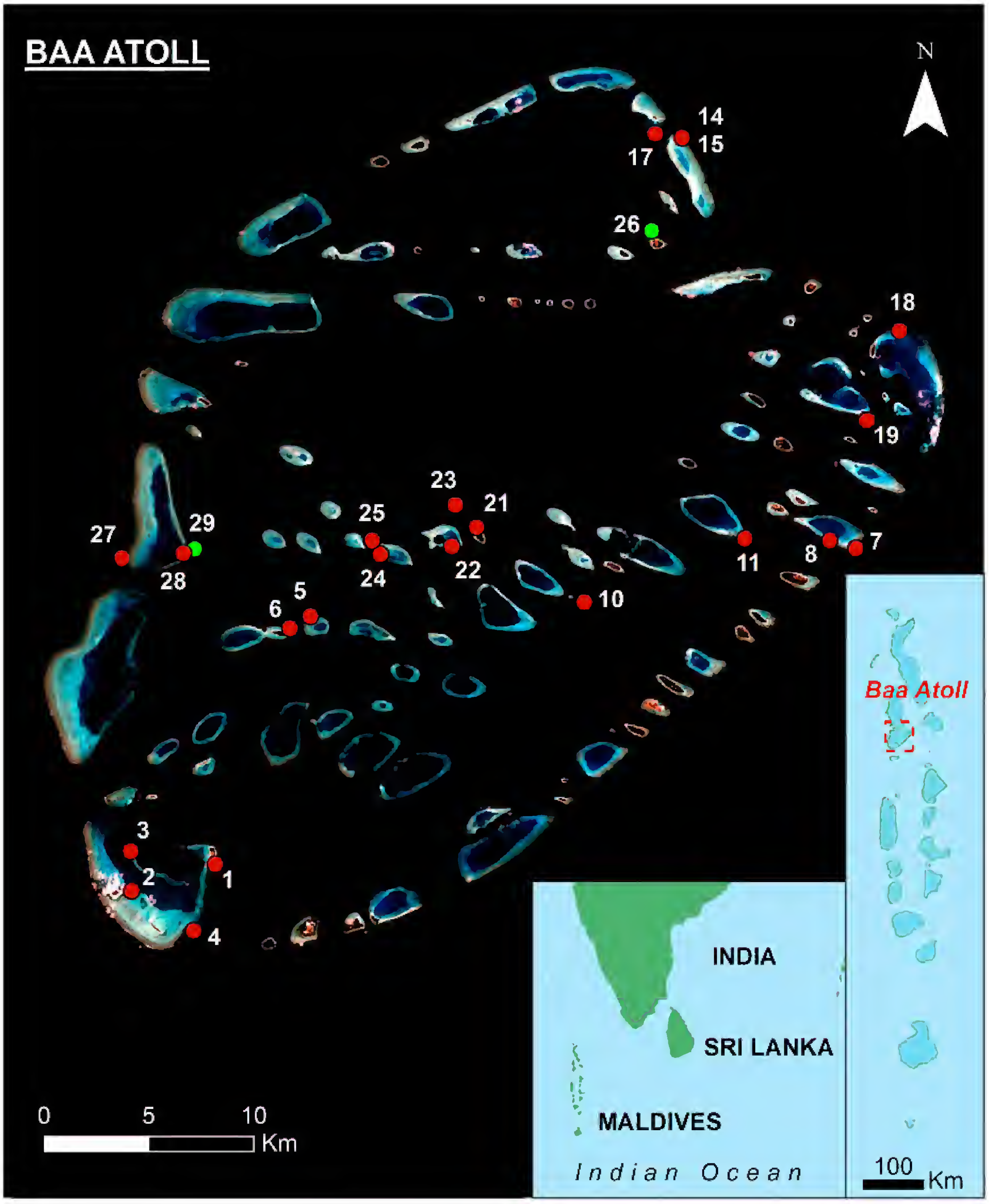

Figure 1. Geographic location of the Maldives Archipelago and Baa Atoll, and sampling stations in Baa Atoll. Six geomorphologic units were differentiated: reef flats of rim faro (2, 8, 15), inner reefs of rim faro (3, 28), lagoon pinnacles, patch reefs/channels and ridge (10, 11, 19, 25), fore reefs of lagoon faro (5, 6, 21, 22, 24), passes of rim faro (1, 4, 17) and outer slopes of rim faro (7, 14, 18, 27). Station 2 was a seagrass bed that yielded no specimen. Two plankton sampling stations (26 and 29) are not studied here (medusae).

Benthic hydroid colonies and pieces of varied substrata supporting or susceptible to support small and microscopic colonies (invertebrates, algae, sea-grasses, limestone, hard bio-constructed substratum…) were collected by hand or with a hammer and a chisel, either by SCUBA diving or snorkeling. Many colonies were of a small size though visible enough to be distinguished underwater. Many other specimens were found only by microscopic observation.

Samples were stored in plastic boxes underwater and when on board disposed in glass dishes with clean seawater renewed frequently. Sorting was done under stereomicroscopes (Leica M3Z) while animals were still alive, and this was augmented by examination with a monocular compound microscope when necessary. Specimens were then fixed in 3% formalin in seawater, and in many cases sub-samples were fixed in ethanol for further genetic studies. Underwater photographs of the largest colonies were taken (Canon Ixus 65). Microphotographs were taken on the boat with a Sony Cybershot DSC-X230. All pictures are from the authors except one from J-L. Menou (see *Gymnangium hornelli* underwater photograph in Appendix 3). Student-Newman-Keuls (SNK) statistical tests were performed with R 2.14.1.

RESULTS

Species Richness and Community Structure

The sampling effort led to a total of 568 benthic specimens. The major part were collected and fixed, and are now gathered at the University of La Réunion. While further refinement is possible, we record 115 hydroid species, 85 leptothecates (74%) and 30 anthoathecates (26%), distributed in 43 identified genera and 26 families (Table 1). No specimen of the order Limnomedusae was found. A preliminary list of species is given in Appendix 1.

Table 1. Distribution of the number of species, genera and families.

	Families	Genera	Species
Anthoathecates	13	17	30
Leptothecates	13	26	85
TOTAL	26	43	115

The most speciose families of this collection are the Aglaopheniidae, Campanulariidae, Haleciidae, Halopterididae and Sertulariidae, for the leptothecates (>10 spp), and the Eudendriidae and Oceaniidae for the anthoathecates (>5 spp). The most speciose genera (>5 spp) are *Clytia*, *Eudendrium*, *Halecium* and *Halopteris*.

Distribution of the Species Richness Inside the Atoll

In the 22 benthic stations (Fig. 1), the hydroid species richness was relatively equally distributed (Table 2). The exception is station 2 where no hydroid was found in the shallow sea grass bed next to the village of Thulhaadhoo. In the deepest station (23 at 50 m deep) the collecting event only lasted a few minutes, so we consider that

the 6 species sampled may not indicate the true species richness of this station. Thus, the distribution of the hydroid species richness is further calculated without taking into account these stations 2 and 23.

The 20 remaining stations included at least 10 species, and 55% exhibited more than 20 species, with a maximum of 33 species for station 7 (east outer slope of rim faro, 0-30 m). The average per station is 21.4 species. The stations 1, 4, 5, 7, 11, 14, 17, 18 and 27 were the most diversified, with at least 25 species sampled. These stations corresponded to outer slopes and passes of the rim faro all around the atoll, except for station 5 which was a fore reef of lagoon faro and station 11 which was a deeper lagoon pinnacle. Station 28 (3-8 m deep, inner reef of rim faro) was the most depauperate because the sandy bottom habitat, dominant there, was inappropriate for benthic hydroid settlement. Four stations having a relative low number of species are located on reef flats of rim faro (stations 8 and 15) and into the lagoon (pinnacle 25 and fore reef 21).

Table 2. Species richness (SR) per station.

Baa stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28	Mean ±SE*
SR	25	0	18	27	26	19	33	14	17	28	27	16	27	27	21	15	17	6	22	14	25	10	21.4±1.4

* mean and standard error (SE) without the stations 2 and 23 (cf. text)

Regrouping the stations according to their geographic situation on the rim faro of the atoll (Table 3), we found no obvious change in species richness from north (50 spp), south (51 spp), east (59 spp) and west (31 spp). The SNK test showed no significant differences ($\alpha = 0.05$). While the species richness means of the rim faro stations versus inside the atoll were not significantly different, the stations from the rim faro yielded a total of 101 species (mean 22.4 spp per station) whereas merged lagoon and faro stations yielded 70 species (mean 19.9 spp per station). Fifty three species were common between lagoon and rim faro, 17 species reported only from the lagoon and 58 species reported only from the rim faro. Thus, while fairly well distributed in Baa Atoll, the species richness was higher on the rim faro versus inside the atoll.

Table 3. Species richness per station according to their geographic location (GL) (except stations n° 2 and 23).

Geographic location (number of stations)	Northern Rim faro (3)	Southern Rim faro (3)	Eastern Rim faro (4)	Western Rim faro (2)	Lagoon (8)	Rim faro (12)
Stations	14, 15, 17	1, 3, 4	7, 8, 18, 19	27, 28	5, 6, 10, 11, 21, 22, 24, 25	1, 3, 4, 7, 8, 14, 15, 17, 18, 19, 27, 28
Species richness	50	51	59	31	70	101
Mean per GL ±SE	23.3 ± 3.7	23.0 ± 2.5	23.8 ± 4.1	17.5 ± 7.5	19.9 ± 1.9	22.4 ± 1.9

The number of hydroid species per geomorphologic unit is given in Table 4 (see Fig. 1 for the station classification). The species richness mean clearly increased from the reef flats and inner reefs (14-15 spp) to the outer slopes and passes of rim faro (26-28 spp) (significant at $\alpha = 0.05$), then into the lagoon and on the fore reefs of lagoonal faro located in the center of Baa Atoll (20 species) (significant at $\alpha = 0.1$).

Table 4. Species richness per geomorphologic unit (GU) from the rim to the center (except stations n° 2 and 23).

Geomorphologic units	Outer slopes of rim faro	Passes of rim faro	Reef flats of rim faro	Inner reefs of rim faro	Lagoon pinnacles, patch reef/channel & ridge	Fore reefs of faro
(Number of stations)	(4)	(3)	(2)	(2)	(4)	(5)
Species richness	60	58	28	23	51	55
Mean per GU ±SE	28 ± 1.7	26 ± 0.6	15 ± 1.0	14 ± 4.0	20 ± 3.0	20 ± 2.1

Species Distribution

The species distribution per station is given in Appendix 2. Several species were eurybathic and widely distributed in Baa Atoll, checked in at least 50% of stations at the depth investigated (0-30 m), located from north to south and east to west (Table 5). Photographs compiled in Appendix 3 document these most common species. Among these species *Sertularella delicata* and *Thyroscyphus fruticosus* were present in 80 and 75% of samplings, respectively, and *Synthecium patulum* was found from 3 to 50 m in depth. Other species, *Antennella secundaria, Clytia latitheca, Halopteris platygonotheca, Hebella scandens* and *Macrorhynchia phoenicea,* inhabited in the range of 3-30 m

Table 5. Common hydroid species reported from different geomorphologic units, and the number of stations from each unit where the species were encountered (species order by decreasing number of total of records).

Species / geomorphologic units	Outer slopes of rim faro	Passes of rim faro	Reef flats of rim faro	Inner reefs of rim faro	Lagoon pinnacles, patch reef/ channel & ridge	Fore reefs of faro	Total
(Number of stations)	(4)	(3)	(2)	(2)	(4)	(5)	(20)
Sertularella delicata	3	2	1	2	3	5	16 (80%)
Thyroscyphus fruticosus	4	2	0	1	4	4	15
Nemalecium sp. 1	4	2	1	2	1	4	14
Dynamena crisioides	2	1	1	1	3	5	13
Gymnangium hians	4	0	1	1	3	4	13
Clytia linearis	4	3	0	0	3	2	12
Dynamena moluccana	4	0	1	2	3	2	12
Synthecium patulum	3	2	2	1	2	2	12
Pennaria disticha	2	3	0	1	2	3	11
Nemalecium lighti	2	0	0	1	2	5	10 (50%)

deep but they were reported in only 20-35% of the stations. *Lytocarpia brevirostris* and *Lytocarpia phyteuma* were more stenobathic, found between 12 and 30 m in depth, while *Macrorhynchia philippina* between 3 and 20 m.

Some species were only found on reef flats, *Plumularia strictocarpa*, *Rhizogeton* sp., while other species were encountered in deeper zones, *Gymnangium hornelli*, *Hebella muscensis,* and *Turritopsis* sp. (30 m), *Bimeria vestita* and *Synthecium* sp. (50 m). *Gymnangium gracilicaule* and *Lytocarpia brevirostris* were mainly sampled in outer slopes or passes of rim faro.

Rare and Interesting Species

Little known species have been collected during the survey. For example *Sertularia maldivensis* Borradaile, 1905, was not reported since its original description. According to Schuchert (2004), *Turritopsis chevalense* (Thornely, 1904) was not reported as well. *Macrorhynchia singularis* (Billard, 1908) is also a rare species recently reported from Indonesia (Schuchert, 2003). Conversely, *Salacia tetracythara* Lamouroux, 1816, a well known species that was reported several times in several SWIO islands where it was abundant (unpublished results and Gravier-Bonnet, 2008), was collected only once in Baa in a deep station.

We suspect that several specimens are from new species but additional taxonomic studies are needed for confirmation. One of the most interesting species, ?*Proboscidactyla* sp., is a very small colony found on the operculum of a sedentary polychete having tiny hydranths very similar to that of *Proboscidactyla* but equipped with four tentacles instead of two. To describe a new genus in the family Proboscidactylidae or change the diagnosis of the genus is not appropriate as, unfortunately, the material collected is poor and sterile. For the completion of the taxonomic study, it will be probably necessary to describe new species for at least one species of the genera *Corydendrium*, *Eudendrium, Turritopsis*, *Antennella*, *Halopteris* and *Plumularia*.

Remark

Only 31% of the 568 registered specimens were fertile, provided with features allowing one to know if they reproduce with a medusa or not, thus allowing for identification with confidence. However, in respect to the species number (115), the percentage of fertile species was 47%.

DISCUSSION

Species Richness and Community Structure: A Regional Comparison

The Maldives Archipelago occupies a large oceanographic area and an interesting location above the Equator in the middle of the Indian Ocean, close to the Indonesian center of biodiversity. However, knowledge of Hydrozoa remained limited, with only 60 species recorded since 1904 for the orders Anthoathecata, Leptothecata and Limnomedusa. The present hydroid dedicated study led to the collection of 115 species.

Among them, 100 species are new records for the Maldives (see Appendix 1), and all are new records for Baa Atoll where no investigation for hydroids was available. The compilation of the Baa list with the historical Maldives list yields an updated number of Maldivian species of around 160.

The species richness of Baa Atoll is high. Compared to other locations previously studied by the authors in the South Western Indian Ocean (Table 6), it is higher than Glorieuses and Juan de Nova Islands (Gravier-Bonnet & Bourmaud, 2006a; 2006b) and close to La Réunion (Bourmaud et al., 2006) and Mayotte, in the Comoros Archipelago (unpublished results of the authors) where past sampling effort was more thorough. In the present state of knowledge, these results indicate a range of variation in the number of species, genera and families of the IO coral reef islands of respectively 88-173, 38-63 and 21-29. The hydroid assemblage of the Siladen coral reefs (Bunaken Marine Park, North Sulawesi, Indonesia), studied on vertical 2.5-50 meters transects, enters this range as made up of 107 species belonging to 51 genera and 28 families (Di Camillo et al, 2008). Adding data of two studies of hydroids in the range of 0-25 meters in Guadeloupe (Galea, 2008, 2010), in the tropical Atlantic, lead to similar numbers for genera (41) and families (28), with a species richness only a bit lower (79). Species richness is certainly underestimated everywhere as the collecting efforts were done either on limited areas or on part of the biotopes only.

Table 6. Species richness of Baa Atoll compared with that of other coral reefs of SWIO islands (Gravier-Bonnet and Bourmaud, published and unpublished results).

	Baa/Maldives	La Réunion	Glorieuses	Mayotte	Juan de Nova
Families	26	29	21	26	26
Genera	43	61	38	63	44
Species	115/160*	160	88	173	95

* adding literature reports

Hydroid species richness in Baa Atoll is spatially well distributed, with an average of 21 species at each site. However species richness was higher on the rim faro than inside the atoll. Moreover, species richness clearly increases from the reef flats and inner reefs to the outer slopes and passes of the rim faro. This result agrees with those reported for other SWIO islands (La Réunion, Glorieuses, Juan de Nova, in Gravier-Bonnet & Bourmaud, 2006 a, b), and for Indonesia (Di Camillo et al, 2008), where the outer slope yields the highest species richness and abundance. The highest species richness of the east outer slope of Baa Atoll (station 33) could be due to specific hydrological conditions at the edge of the atoll facing the internal oceanic zone in between the east and west atoll series.

The community structure of the Baa Atoll hydroid fauna is similar to other tropical islands investigated in SWIO where leptothecates provided 72 to 75% of the hydroid species richness (Table 7). Thus, the typical hydroid community structure of both Indian Ocean tropical areas and some other areas distributed worldwide (Gravier-Bonnet & Bourmaud, 2006a; Di Camillo et al., 2008) is confirmed here, with dominance of leptothecates whereas anthoathecates represent only 19-35% of the fauna.

Table 7. Indian Ocean hydroid community structure: percentages (%) of leptothecates, and number of species for the five most speciose families (Gravier-Bonnet and Bourmaud, published and unpublished results).

	Leptothecates	Sertulariidae	Aglaopheniidae	Campanulariidae	Halopterididae
Baa	74	14	14	12	11
Réunion	73	22	15	8	10
Glorieuses	74	16	12	7	7
Juan de Nova	72	12	19	5	6
Mayotte	75	30	21	17	13

In the SWIO islands, the Aglaopheniidae and Sertulariidae were the two major families (Table 7), and the most speciose genera were either *Macrorhynchia-Gymnangium* for aglaophenids, or *Dynamena-Sertularella* for sertulariids. Even if most of their species are large and easy to detect underwater unlike small or tiny species, the present results confirm that in coral reefs of the remote tropical islands of the Indian Ocean the two families Aglaopheniidae and Sertulariidae predominate inside the hydroid fauna. Baa Atoll and Mayotte fauna is distinguished from the others by having, in addition, two other families much more diversified than elsewhere, the Halopterididae (major genus *Halopteris*), and the Campanulariidae (major genus *Clytia*). The family Haleciidae (major genus *Halecium*) is usually also well developed, including Baa Atoll (11 spp). Further extensive taxonomic studies might yield these taxa to reach the first or second range. Within anthoathecates, the family Eudendriidae was the most speciose (7 spp) in Baa like in the previously investigated islands, and so was the genus *Eudendrium*. This trend is also reported in the Siladen Island coral reefs (Sulawesi, Indonesia) where the most widely represented leptothecate families are the Sertulariidae, Aglaopheniidae, Halopterididae and Plumulariidae, while the anthoathecate ones are Zancleidae and Eudendriidae, in descending order (Di Camillo et al, 2008).

Unexpected results concern the two families with calcareous skeleton protected by the CITES convention, namely the Milleporidae and the Stylasteridae (previously named hydrocorals). Previous studies done in other atolls of the Maldives Archipelago reported (a) *Millepora* as one main reef organism in shallow (0-7 m) areas, where it built some "*Millepora* zone" (Morri et al. 1995), (b) the massive species *Millepora platyphylla* (Boschma, 1948; Coleman, 2004) and two branched species, *Millepora tenera* (Wells & Davies, 1966; Coleman, 2000; Lewis 2006) and *Millepora latifolia* (Wells & Davies, 1966). In Baa Atoll, we observed no *Millepora* zone and we reported only a single colony of *Millepora ?platyphylla* (see Appendix 1 for question mark). The 1997-98 El Niño Southern Oscillation event (ENSO) induced a strong bleaching and a massive coral mortality (of up to 90%) in the tropical Indian Ocean, including the Maldives (Wilkinson et al, 1999; McClanahan, 2000). Like scleractinians, fire corals are very sensitive to bleaching, and *Millepora platyphylla* in the Maldives was severely damaged during this worldwide event (Lewis, 2006). Only two colonies of plating *Millepora* were seen in a 1999 survey done in several central atolls of the Maldives Archipelago, whereas this genus was the fifth most common genera in 1958 (McClanahan, 2000). He also observed no branching *Millepora* species during his survey and concluded *"Millepora tenera* and *M. intricata* are among those species likely to be locally extirpated". Coral

recolonization started in 1999 but no *Millepora* recruits were observed (McClanahan, 2000; Bianchi et al, 2006). By 2002, if the coral cover remained low, coral diversity had not decreased, but some previously abundant species had become rare and *Millepora* had completely disappeared (Bianchi et al, 2006; 2009). The unique *Millepora* colony found in Baa Atoll ten years after this El Niño event suggests that similar extirpation may have happened elsewhere in the Maldives Archipelago and that *Millepora* spp colonies have not been able to recover after the bleaching. Similar events in the eastern Pacific also reduced *Millepora* to such low levels that it is nearly locally extinct (Glynn & Weerdt, 1991; Glynn & Feingold, 1992). Conversely, we observed many locations characterized by abundant *Heliopora coerulea* colonies in the environment usually inhabited by milleporids. *Heliopora coerulea* was apparently not affected by SST anomalies (Bianchi et al, 2006). The single *Millepora* colony observed in Baa was not in the very shallow waters, likely explaining its survival at a time of heat stress. It brings some hope for further recolonization if a few other colonies of both sexes are present in the vicinity (Bourmaud et al., submitted). Regarding stylasterids, colonies of the two tropical shallow water species recorded, *Distichopora violacea* and *Stylaster roseus*, were rare and reported at only a few stations in Baa, while usually common and largely distributed in SWIO islands.

Surprisingly, despite the fact that the family Aglaopheniidae is one of the most speciose of the collection, the widespread species known from Indonesia to Africa, *Aglaophenia cupressina* (spelled “fire-weed” for its stinging properties) was missing from Baa Atoll, though environmental conditions were favorable. It was not previously reported in Maldives as well. Remarkably, this species is also absent from the Mascarene Archipelago, and thus seems missing from large areas located both in the North (Maldives) and in the South (Mascarene, unpublished data) of the main South Equatorial current allowing species dispersal from the Eastern hot-spot of biodiversity. Similarly, not a single species of the genus *Solanderia* was reported in Baa, although it is reported in the Maldives (Coleman, 2000) and several species of this genus are commonly found in the Indian Ocean (Bouillon et al., 1992; Vervoort, 1993; Gravier-Bonnet & Bourmaud, 2006a,b).

Other differences in the species composition of Baa, compared to the SWIO islands, is the absence of the family Kirchenpaueridae, usually represented by one species, and of some genera (*Diphasia*, *Hincksella*, *Thuiaria*) and species usually found, like the large and deep *Macrorhynchia sibogae* (Billard, 1913) and *Sertularella diaphana* (Allman, 1886), and the epizoan *Diphasia digitalis* (Busk, 1852). The rarity of *Salacia tetracythara* Lamouroux, 1816 is also noticeable. Conversely, the family Oceaniidae is well diversified and the sertularid *Sertularella delicata,* rather rare in SWIO, was very common during our survey in Baa Atoll. We hypothesize that this last species hides a species complex in the Indian Ocean, and further molecular investigations are warranted to test this.

Species Distribution

Marine phanerogames and many algae are usually good substrata for hydroids (Oliveira & Marques, 2007), as demonstrated in the Indian Ocean (Gravier, 1970; Gravier-Bonnet & Bourmaud, 2005). Surprisingly, no hydroids were found in the seagrass bed investigated in Baa Atoll. This bed was monospecific, formed by *Thalassia hemprichii*. Many species were found in monospecific *Thalassodendon ciliatum* seagrass beds in Glorieuses and Mayotte, whereas, on the opposite, only two were found in *Syringodinium isoetifolium* beds in La Réunion (unpublished data). Thus, monospecificity alone cannot explain the absence of hydroids. It might be rather the consequence of the leaves surface quality of the substratum, as some phanerogame species are more colonized by hydroids than others, for instance *T. ciliatum* compared to *T. hemprichii* (Gravier, 1970).

Comparisons with other SWIO surveys (published and unpublished authors data) allow describing hydroid species distribution and ecology on coral reefs in this region. Several Baa Atoll species collected mainly on hard substrata, are common and characteristic species of tropical Indian Ocean shallow waters. There are eurybathic species (*Dynamena crisioides*, *D. moluccana*, *Gymnangium hians, Lytocarpia phyteuma, Nemalecium* sp.1*, N. lighti, Synthecium patulum, Thyroscyphus fruticosus)*, whereas others are rather stenobathic (*Lytocarpia brevirostris*, *Macrorhynchia phoenicea*, *M. philippina*). Other species linked to currents are characteristic of outer slopes and passes (*Macrorhynchia spectabilis, Plumularia spiralis*).

Hydroids in Baa Atoll displayed large populations in several sites, while in others they were less abundant but diversified as well. When in large populations, the largest species were one of the main components of the underwater landscape (see Plates). These large species with ten to thirty centimeter-long erected colonies mainly belong to leptothecates, and to the family Aglaopheniidae, especially *Gymnangium*, *Lytocarpia* and *Macrorhynchia* species. They usually sheltered diversified sessile and vagile microflora and microfauna, with other hydroid species either obligatorily associated or not.

CONCLUSION AND PERSPECTIVES

The present extensive study of hydrozoan communities in Baa Atoll provides new data that improve the state of knowledge of marine biodiversity of Indian Ocean countries, recently reviewed by Wafar et al. (2011). It yielded a significant increase in known hydroid species richness for the Maldives Archipelago (x2.5), with 100 species recorded for the first time, and the first estimation specific to Baa Atoll. However, 44% of the coral reef habitats of Baa Atoll were not sampled (Andréfouët et al., 2010 and this issue) like for example the bottom of the lagoon and many reef flats. Thus, the estimates provided here are conservative. Further investigations are warranted to complete exhaustively the census of hydroids for Baa and the Maldives, and to assess if missing taxa like *Millepora* are susceptible to come back. Regionally, the Baa census provided fresh new results that confirm previous knowledge, but also pose biogeographic questions in terms of presence/absence of species otherwise absent or dominant in the region.

Many specimens of the collection have not yet been fully identified. Lack of reproductive structures on specimens and need for additional taxonomic studies for several genera prevented the complete identification of all samples. Besides this collection, 300 additional samples were conserved in alcohol for further genetic studies. Genetic data have recently assisted in taxonomic studies of hydrozoans (for example Schuchert, 2005; Miglietta et al., 2007 & 2009; Miranda et al, 2010; Moura et al., 2011 & 2012). They could address several taxonomic problems encountered during the present study, especially to compare sterile specimens with fertile ones, and to separate closely related species.

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Appendix 1.
Annotated checklist of the species collected in Baa Atoll during the 2009 survey.

Families inside sub-orders and genera inside families arranged in alphabetical order and classification according to Peter Schuchert (2009) World Hydrozoan database available online at http://www.marinespecies.org/hydrozoa.
✷ Species photographed in Appendix 3. ♦ Species already reported in the Maldives Archipelago, sometimes under another name (15spp).

ANTHOATHECATA Cornelius, 1992
FILIFERA Kühn, 1913

Bougainvilliidae Lütken, 1850
Bimeria vestita Wright, 1859
Two sterile colonies collected at the same station, stolonal and growing on stems of other hydroids. Pseudo-hydrotheca and base of tentacles embedded by particulate matter. Hydranth very tiny, with 9-10 tentacles, the top of which only is visible.

Eudendriidae L. Agassiz, 1862
Species were separated during the field trip mainly on shape and color of living colonies.

Eudendrium racemosum (Cavolini, 1785) ✷ ♦
The largest and most frequent *Eudendrium* species in Baa Atoll. Branched colony brown, not in a plane, with large hydranths and gonophores orange. Characteristic nematophores were present only on some hydranths. We suspect that *Eudendrium maldivense* described by Borradaile (1905, pl. 69, fig. 1) is a synonym of *E. racemosum*. The general shape of the colony and male gonophores are similar but, however, Borradaile did not notice any nematophore on hydranths. On our material, such nematophores were rare. They could have been even more rare on Borradaile colony as about all the hydranths bear male gonophores on their body in the same place as nematophores.
Eudendrium sp. 1
Eudendrium sp. 2
Eudendrium sp. 3
Eudendrium sp. 4
Eudendrium sp. 5
Eudendrium sp. 6
Colonies of this bright red species were encountered twice. It could be a new species.

Oceaniidae Eschscholtz 1829
Cordylophora sp.
Sterile colony partly stolonal, with several erected sympodial stems (0,8 cm) bearing only two to four hydranths. Tubes of hydranths free on most of their length, but some having a very short part like nested. Hydranths spindle shaped bearing about 25 scattered tentacles, orange in life.

Corydendrium corrugatum Nutting, 1905

The presence of an anterior and rear side for the colony is typical of *C. corrugatum* according to Schuchert (2003), and distinguishes it from *Corydendrium parasiticum*. We collected sterile colonies having this character, small ones twice (2 cm, of which one with stolonal hydranths on the stem of *Gymnangium hornelli*), and one large (7 cm) tree-liked, fasciculate, branching with a large angle (about 90°), branches clearly having two different faces and a hand shape. Tubes supporting hydranths of large diameter, adnate on most of their length and directed on one side, with corrugations not well marked on the free part. Large hydranths provided with 40-50 tentacles, tissues and hydranths bright yellow for the largest colonies. Differences in tentacle number and color for the small colonies (respectively orange and white) raise questions.

Corydendrium sp.

Sterile colonies collected in a plane (3 cm), both fasciculated and ramified, with no obvious difference from ventral versus dorsal face. Free part of tubes short to very short, thus hydranths being about adnate to the stem. Very large hydranths provided with up to 30 tentacles, light orange or transparent. Rees & Vervoort (1987) reported *Corydendrium parasiticum* (Linnaeus) from 37 m deep near the Maldives islands by (04° 50' 18" - 04° 53' 00" N, 72° 52' 48" - 72° 55' 24" E), but our specimens exhibit a different colony shape. As the few other *Corydendrium* species described have very different geographical distribution, this one could belong to a new species.

Rhizogeton sp.

Colony stolonal, hydranth base covered by a short collar of skeleton. Hydranths elongated with scattered tentacles on the whole body. Most often the polyps exhibit characteristic small white dots at the tentacle base. This species is widely distributed in the Indian Ocean (description in progress).

Turritopsis chevalense (Thornely, 1904) ✷

Specimens from Baa agree with the original description of the polyp stage of this little known species of which the medusa is unknown. Moreover, *T. chevalense* was described from the Indian Ocean, while *Turritopsis nutricula* McCrady, 1857 is an Atlantic species (Schuchert, 2004; Miglietta et al, 2007). Schuchert (2003) noticed "the *Turritopsis* species of the tropical Indo-Pacific might all be referable to *T. chevalense* described from Ceylon, but that they are at present not distinguishable from other *Turritopsis* hydroids". In waiting the genetic study of the Baa samples, we keep together colonies that differ in the color of hydranths and tissues (white or bright yellow), general shape (more in a plane or more bushy), and number of hydranth tentacles (from 15 to 30), and thus that could include multiple species. Observed several times, medusa buds were inserted, as described by Thornely, along the free part of the tubes, below the hydranths, with different developmental stages at the same time, except in one instance where they were both all sited at the same level on a circle around the tube and at about the same age. New-borne medusae are provided with 4 radial canals, 8 tentacles, and embryonic gonads as 4 pads (yellow on some) on the median part of the manubrium. Tentacles exhibit a typical posture directed to the apex of the umbrella and enroll on themselves while swimming. Bigelow (1904) reported one unidentified *Turritopsis* sp. medusa collected in a tow at Felidu Atoll.

Turritopsis sp.

Two tiny colonies collected (0.5 cm), mainly stolonal. The larger one with a few erected stems monosiphonic, bearing few hydranths, tubes with a free part forming an angle of about 45° with the stem. A single medusa bud was growing on tube just below hydranth. Hydranths with 15 tentacles, white when alive. For the general shape of the colony and stolonal hydranths, this species looks like *Corydendrium album* Hirohito, 1988, but the gonophore here is, without any doubt, a medusa. As no similar species was found in the recent reviews done on the genus *Turritopsis* (Schuchert, 2004; Miglietta et al, 2007) this species is probably a new species. More fertile material and the rearing of the medusa could provide better data and correlations with some species known from fully-grown medusae only.

Pachycordylidae Cockerel, 1911

?Pachycordyle sp.

A few hydranths on a sterile colony settled on *Thyroscyphus fruticosus*, reported once.

Proboscidactylidae Hand & Hendrickson, 1950

?Proboscidactyla sp.

A sterile colony on the operculum of a Polychete, with few hydranths looking like *Proboscidactyla* hydranths but having 4 tentacles instead of 2, probably a new species which will require modification of the diagnosis of the genus. *Proboscidactyla varians* was a new species described by Browne (1904) from a single medusa collected at Miladumadulu Atoll. Later considered as probably an abnormal specimen of *Proboscidactyla ornata* by Mayer (1910), this species was excluded from a recent catalogue (Bouillon et al., 2006).

Stylasteridae Gray, 1847

Distichopora violacea (Pallas, 1766) ✷ ♦

Usually common in Indian Ocean coral reefs, colonies of *D. violacea* were rarely observed in Baa Atoll and found at only four stations. It was however already previously recorded in the Maldives archipelago (Coleman, 2000). On the color plates below, the small colony of *Distichopora* photographed near *Stylaster roseus* (but not collected) could be either a orange colored colony of *D. violacea*, a species variable in color, or another species, *Distichopora nitida* Verrill 1864, that has thinner branches and was previously reported from the Maldives by Scheer & Obrist (1986), and probably also by Coleman (2000) as *Distichopora* sp.

Stylaster roseus (Pallas, 1766) ✷

As for *D. violacea*, *S. roseus* was a rare species in Baa (reported in only three stations).

CAPITATA Kühn, 1913

Cladocorynidae Allman, 1872

Cladocoryne haddoni Kirkpatrick, 1890

Corynidae Johnston, 1936
Coryne nipponica (Uchida, 1927)

Milleporidae Fleming, 1828
Millepora ?platyphylla Hemprich & Ehrenberg, 1834 ✷ ♦

The general shape of the single colony encountered during this study is not typical for shape and color (see color plates), but it looks like other colonies that we sampled in the Comoros Archipelago. Genetic studies are now in progress to study varied growth morphs of *M. platyphylla* in the Indian Ocean where we suspect the presence of cryptic species. The typical growth morph of *M. platyphylla* is that photographed in Coleman (2000). According to Boschma (1948), *M. platyphylla* was recorded in the Maldives Islands "under the name *Millepora complanata,* first by Darwin (1842) and then by Sewell (1936)" from Horsburgh or Goifurfehendu Atoll.

Pennariidae McCrady, 1859
Pennaria disticha Goldfuss, 1820 ✷ ♦

Previously checked by Coleman (2000).

Sphaerocorynidae Prévot, 1959
Sphaerocoryne bedoti Pictet, 1893

Tubulariidae Fleming, 1828
Ectopleura viridis (Pictet, 1893) ✷ ♦

Previously checked in the Maldives as *Tubularia pacifica* (Thornely, 1900) by Borradaile in 1905 (recent literature: Schuchert, 2003; Calder, 2010). Hydranth up to 1.5 cm with pedicel, bottom rounded, a circle of 25 long tentacles at base and 12 shorter around the mouth, bunches of medusa buds between the two circles. Medusa buds with two tentacles.

Tubulariidae indet.

Hydranths with pedicels up to 0,6 cm, with 12-13 long tentacles at base and 7 very short around the mouth having nematocysts concentrated at top (pseudo-capitations), gonophores very young settled in between, either isolated or in bunches of three according to the hydranths. Because of its smaller size, thinner and shorter tentacles, and hydranths not rounded at base, this is probably a different species than *E. viridis* and not juveniles hydranths. It was not identified because of immature gonophores.

Zancleidae Russell, 1953
Zanclea sp.1

Associated with hard corals. Hydranths transparent provided with numerous capitate tentacles, small medusa buds growing on long pedicels.

Zanclea sp. 2

Associated with bryozoans. Hydranths transparent, except for the white hypostome, equipped with 5 oral tentacles with large capitations, tentacles on the body both shorter and with a smaller diameter of capitations.

Zanclea sp. 3

Associated with bryozoans. Hydranths transparent except for white hypostome and dots inside the capitations of tentacles, 6 long oral tentacles with large capitations and others long tentacles on the body provided with smaller capitations.

Zanclea sp. 4

Species not associated with other sessile animals, but conversely growing on other substrata. Hydranths entirely transparent, provided with 6 long oral tentacles and about 30 tentacles on the body, whose length shortens gradually towards base.

Capitata indet.

On a Bryozoan, tentacle-like hydranths transparent very tiny, immerged in the colony substratum after fixation.

LEPTOTHECATA Cornelius, 1992

CONICA Broch, 1910

Aequoridae Eschscholtz, 1829

Aequorea sp.

A single sterile colony was collected, however confirming the presence of the genus. A fragmentary specimen of a medusa of *Aequorea coerulescens* (Brandt, 1838), a Pacific species, was reported by Bigelow (1904) from the Maldives, but said to be "insufficient for positive identification" by Boone (1938). *Aequorea maldivensis* Browne, 1904, was described as a new species from three specimens collected in Haddumati Atoll, but was later considered a synonym of *Aequorea macrodactyla* by Mayer (1910).

Aglaopheniidae Marktanner-Turneretscher, 1890

Aglaophenia postdentata Billard, 1913

The *Aglaophenia gracillima* described as a new species by Borradaile (1905) from some sterile fragments dredged at 50 meters deep in Miladumadulu Atoll is very close to the specimens of *A. postdentata* we collected in shallow waters in Baa during this study. They both have the same shape and characters for hydrotheca and nematothecae, but on *A. gracillima* the impair adcauline tooth of the hydrothecal aperture is absent (9 teeth instead of 10) and the articles on hydrocladiae are longer. *Aglaophenia gracillima* Borradaile, 1905 is not listed in Bouillon et al (2006). It differs strongly from *Aglaophenia gracillima* Fewkes, 1881, a species described earlier and probably unknown to Borradaile who created a homonym. A revision of Borradaile's collection and more material from the Maldives is necessary to decide if his *A. gracillima* is a valid species and eventually give it a new name.

Gymnangium ?eximium (Allman, 1874) ✷

The colonies provisionally so identified are not provided with a lateral tooth at the orifice of the hydrotheca as described in the literature, and observed previously on specimens from the Indian Ocean (Mammen, 1965; Rees & Vervoort, 1987). They are closer to specimens from the Pacific (French Polynesia) described with a "blunt" lateral tooth, so blunt that it is about invisible on the drawings (Vervoort &

Vasseur, 1977, p. 82, fig. 34). In the absence of a lateral tooth on Baa specimens of *G. ?eximium*, the hydrothecae of this species are very close to that of *G. gracilicaule* but their colonies differ in color (yellow green/white), general shape (strictly in a plane/not), consistency (sturdy/slender) and ramifications (motionless/mobile around a basal hinge joint) (see plates in Appendix 3), and the gonothecae also are different, though all flat. Genetic studies are in progress on these related species.

Gymnangium gracilicaule (Jäderholm, 1903) ✷

See the brief comparative description in *G. ?eximium.*

Gymnangium ?gracilicaule (Jäderholm, 1903)

Two specimens have been kept separately in respect of the absence of hinge joint at the base of the branches and of the presence of longer hydrothecae than in the typical form.

Gymnangium hians (Busk, 1852) ✷

We suspect several cryptic species to be included in the specimens identified as *G. hians* in Baa, as in other parts of the world. Genetic sub-samples will probably permit to solve this problem.

Gymnangium hornelli (Thornely, 1904) ✷

Whereas this species has an hydrotheca of a shape very similar to those of *G. ?eximium* and *G. gracilicaule*, though slightly longer, the colonies are different from both. The main character that differentiates this species is the presence on the stems and branches of modified hydrocladiae all along enrolled around, provided of nematothecae only, and very fragile, thus falling down easily on fixed material. Moreover, the colonies are not in a plane, and the branches are spirally inserted around the stem and connected by a shorter hinge joint than for *G. gracilicaule* (see plates in Appendix 3).

Lytocarpia brevirostris (Busk, 1852) ✷ ♦

Previously reported from the Maldives (Hulule, Male Atoll) by Borradaile (1905) as *Aglaophenia maldivensis* n. sp., a species put in synonymy by Billard (1913) according to the description and drawing given by Borradaile, and though the presence of hydrothecae on corbula costae was not checked.

Lytocarpia delicatula (Busk, 1852) ✷ ♦

Previously reported from the Maldives (S Nilandu) by Borradaile (1905), and a photograph of this flexuous feather like species is in the chapter "The Hydrozoans" of the book of Anderson (1991, p. 57).

Lytocarpia phyteuma (Kirchenpauer, 1876) ✷

Macrorhynchia philippina Kirchenpauer, 1872 ✷ ♦

Previously checked by Coleman (2000). As for *G. hians*, we suspect several cryptic species under this name in the Indian Ocean (genetic studies in progress).

Macrorhynchia ?philippina Kirchenpauer, 1872

A single specimen that could be a juvenile form of *M. philippina* or a close species.

Macrorhynchia phoenicea (Busk, 1852) ✷ ♦

Previously reported from the Maldives by Borradaile (1905) from Male, Addu, S Nilandu and Malhos Atolls, and by Morri et al (1995) from Ari Atoll. Under this name we have gathered numerous specimen that could have been separated in groups for weak differences and that will be further compared genetically.

Macrorhynchia singularis (Billard, 1908) ✷
This is a rare species originally described from New Guinea and recently reported in Indonesia (Schuchert, 2003). This is the second record for the Indian Ocean, as previously reported in Madagascar (Tuléar) by Pichon (1978) and identified by N. Gravier-Bonnet.

Macrorhynchia spectabilis (Allman, 1883) ✷ ♦
A photograph in the chapter "The Hydrozoans" of the book of Anderson (1991, p. 57) is probably *M. spectabilis*.

Campanulinidae Hincks, 1868

Campanulinidae indet.

Cirrholoveniidae Bouillon, 1984

Cirrholovenia tetranema Kramp, 1959 = *Lafoeina amirantensis* (Millard and Bouillon, 1973)
This species was originally called *Egmundella amirantensis* by the authors and then transferred to the genus *Lafoeina* by Calder (1991). Recently, Migotto & Cabral (2005) studied its life cycle and discovered that it is the polyp phase of the medusa *Cirrholovenia tetranema* Kramp, 1959. As the medusa was described first, the species must be spelled according to the medusa name.

Haleciidae Hincks, 1868

Halecium sp. 1
Halecium sp. 2
Halecium sp. 3
Halecium sp. 4
Halecium sp. 5
Halecium sp. 6
Hydrodendron gardineri (Jarvis, 1922)
Hydrodendron sp.
The single sterile and stolonal colony collected was growing on *Dynamena crisioides* and had the type shape that characterized previously the genus *Ophiodissa* nowadays in synonymy with *Hydrodendron*.

Nemalecium lighti (Hargitt, 1924) ✷
Large branched photophilic colonies of a white color, found on varied substrata.

Nemalecium sp. 1
This species, close to *N. lighti* but smaller and of a bright white-blue color, is very common in Indian Ocean shallow waters. Previously reported as *N. lighti*, some of its biological and ecological traits have already been published (Gravier-Bonnet & Mioche, 1996). The morphological description of the two new species (*Nemalecium* sp. 1 and sp. 2), together with the result of the genetic study of the *Nemalecium* group, will be published separately.

Nemalecium sp. 2

Halopterididae Millard, 1962
Antennella incerta Galea, 2010
Antennella secundaria (Gmelin, 1791)
Antennella sp. 1

Stems rigid, obviously and regularly segmented by alternate oblique and straight joints. Hydrothecae short and regular, with convex abcauline wall only sometimes slightly curved just under the aperture. Lateral nematotheca short but inserted on a long peduncle, never reaching the hydrothecal aperture, with upper chamber very wide. Tissues and hydranths bright yellow.

Antennella sp. 2

Very large and high hydrotheca with a slightly convex abcauline wall not at all curved below aperture and a very long straight adcauline wall. Lateral nematothecae inserted on long pedicel, long and tubular, with upper chamber glass-shaped with even orifice and only slightly enlarging from base to top, growing much over the aperture of the hydrotheca. A median impair nematotheca is present above the hydrotheca. Hydrothecae of a similar shape and provided with long lateral nematothecae are considered as variations of the variable species *Antennella secundaria* by Schuchert (1997). As we did not observe in our Baa specimens any intermediary form between *A. secundaria* and *Antennella* sp. 2, we consider this last as a new species to be described.

Halopteris platygonotheca Schuchert, 1997

Living specimens of this large species have stems evenly colored in light green. Female gonothecae are very large and flattened but contain a single big oocyte.

Halopteris sp. 1
Halopteris sp. 2
Halopteris sp. 3
Halopteris sp. 4
Halopteris sp. 5
Monostaechas quadridens (MacCrady, 1859)

Hebellidae Fraser, 1912
Hebella furax Millard, 1957
Hebella laterocaudata Billard, 1942
Hebella muscensis Millard & Bouillon, 1975
Hebella scandens (Bale, 1888) ♦

Already recorded by Borradaile (1905) as *Lictorella scandens.*

Hebella sp.

Lafoeidae A. Agassiz, 1865
Filellum sp.
Zygophylax rufa Bale, 1884 ✷ ♦

Colony growing in a plane, with skeleton colored in red both on stems and branches. Some colonies almost deprived of nematothecae. From two Maldives atolls (Northern Malé and Goifurfehendu), Borradaile (1905) reported *Lictorella halecioides* Allman,

though he described differences between his material and Allman's one, which seems to be *Zygophylax rufa*. He also made a large mistake in describing the gonotheca for the first time whereas it is, without any doubt, the hydrotheca of an epizootic *Hebella* species. Coleman (2000) also reported a *Zygophylax* sp.

Plumulariidae McCrady 1859

Plumularia group *setacea* (Linnée, 1758)

This group that includes related species distributed worldwide is now in revision by Peter Schuchert.

Plumularia spiralis Billard, 1911 ✷

Plumularia strictocarpa Pictet, 1893

Plumularia sp.

This species is related to *Plumularia badia* Kirchenpauer, 1876, but the branching is very different and probably indicates that this *Plumularia* is a new species.

Sertulariidae Lamouroux, 1812

Dynamena moluccana (Pictet, 1893) ✷

Dynamena cornicina McCrady, 1859

Dynamena crisioides Lamouroux, 1824 ✷ ♦

In Baa Atoll, this species was found in two forms: the classical described by Lamouroux and one longer, named var. *gigantea* by Billard in 1925. We agree with Billard (1925) who signaled that the new species described by Borradaile (1905) as *Synthecium maldivense* is without any doubt *D. crisioides gigantea* for its coral reef habitat and the disposition of hydrothecae.

Dynamena sp. 1

Dynamena sp. 2

Idiellana pristis (Lamouroux, 1816) ♦

This species has been previously recorded in the Maldives, in Suvadiva and Male Atolls (Borradaile, 1905).

Salacia desmoides (Torrey, 1902)

Salacia tetracythara Lamouroux, 1816

Sertularella delicata Billard, 1919 ✷

The characters allowing to distinguish easily this species from *Sertularella diaphana* (Allman, 1886) are its peculiar lace growing more or less in a plane, and its bright yellow color. *S. diaphana* develops large erected colonies with polysiphonic stems giving rise to branches in three dimensions like a tree, and is of a salmon-pink color.

Sertularella robusta Coughtrey, 1876

Colony simple, hydrothecae long and narrowing at orifice, with corrugations and a single empty gonotheca with corrugations in the upper part and a neck provided with very obtuse teeth.

Sertularella sp. 1

Specimens related to that of *S. robusta* for colony and hydrotheca shapes, but with either no corrugations on hydrotheca or only inconspicuous ones on adcauline side, and with large corrugated female gonothecae narrowing at the aperture but without a

true neck and teeth. Planulae were developing in an acrocyst, about ten in each. These specimens have been kept provisionally separated from *S. robusta* for different shape of the gonotheca and because of the lack of corrugations on the hydrotheca. However, colony and hydrotheca shapes being similar, it could be a sexual dimorphism that we can't verify as the single gonotheca of *S. robusta* we recovered is empty.

Sertularella sp. 2

Colony simple, with hydrothecae about quadrate having smooth walls and provided with 4 internal teeth.

Sertularia distans (Lamouroux, 1816)

This species was found settled on a bit of leave of a marine Phanerogam (*Thalassia*) thrown on the boat deck.

Sertularia maldivensis (Borradaile, 1905) ♦

Originally described by Borradaile as *Thuiaria maldivensis*. Schuchert (2003) regards this species as possibly a synonym of *Sertularia borneensis* Billard, 1925. Hydrothecae, on the single colony collected, are closed to those figured by Borradaile, and differ from that of *S. borneensis* in having the length of the adnate part about equal or shorter than the free. Fertile specimen is needed to go further in identification. This is the second record for the Maldives as it was previously collected at Suvadiva Atoll (Borradaile, 1905).

Sertularia sp.

Syntheciidae Marktanner-Turneretscher, 1890

Recent literature on the genus *Synthecium* (Watson, 2000; Schuchert, 2003) demonstrated how difficult is the identification of species, even with fertile specimens. This is the case for three related species, *Synthecium patulum* (Busk, 1852), *Synthecium orthogonium* (Busk, 1852), and *Synthecium campylocarpum* Allman, 1888. Two of the four Baa species belong to this group and are here tentatively identified, pending more data and genetic studies.

Synthecium flabellum Hargitt, 1924 ✷

Large colonies of a dark brown, nearly black, provided with gonothecae, classical in shape.

Synthecium ?orthogonium (Busk, 1852) ✷

Small colonies of a deep dark red, provided with gonothecae elongated and flattened, with corrugations, rounded on top or sometimes with a very short narrowing below the orifice.

Synthecium patulum (Busk, 1852) ✷

Colonies uncolored, with long saussage shape male gonothecae with 8-9 strong corrugations, female also corrugated but shorter and rounded. Baa specimens are provisionally attributed to *S. patulum* because it is clearly related to that of Billard (1925). However, Watson (2000) and Schuchert (2003) think that Billard's specimens of *S. patulum* have to be put in synonymy with *Synthecium orthogonium*.

Synthecium sp.

Small colonies absolutely black, provided with large hydrothecae about half adnate

on the hydrocladium and half free. Specimens collected at 50 meters, without gonophores.

Thyroscyphidae Stechow, 1920

Thyroscyphus fruticosus (Esper, 1793) ✷ ♦

Described from the Maldives as a new species by Borradaile (1905), *Campanularia junceoides* is probably a synonym of *T. fruticosus*.

PROBOSCOIDA Broch, 1910

Campanulariidae Johnston, 1836

Campanularia sp. 1
Campanularia sp. 2
Campanularia sp. 3
Clytia hummelincki (Leloup, 1935)
Clytia gracilis (M. Sars, 1850)
Clytia latitheca Millard & Bouillon, 1973
Clytia linearis (Thornely, 1900) ✷
Clytia sp. 1
Clytia sp. 2
Clytia sp. 3
Clytia sp. 4
Obelia dichotoma (Linnaeus, 1758)

Leptothecata indet. sp. 1
Leptothecata indet. sp. 2
Leptothecata indet. sp. 3

Appendix 2. Species distribution among stations in Baa Atoll.

Genera	*species* / stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28
Aequorea	sp.				1																		
Aglaophenia	*postdentata*												1			1							
Antennella	*incerta*	1							1														
Antennella	*secundaria*	1			1			1	1									1				1	
Antennella	sp. 1										1		1										
Antennella	sp. 2																		1				
Antennella	indet.			1																		1	
Bimeria	*vestita*																		1				
Campanularia	sp. 1								1														
Campanularia	sp. 2																					1	
Campanularia	sp. 3										1												
Campanularide	indet									1													
Campanulinide	indet													1									
Capitata	indet	1																					
Cladocoryne	*haddoni*											1										1	
Clytia	*gracilis*				1	1	1	1							1					1			
Clytia	*hummelincki*																1			1			1
Clytia	*latitheca*	1		1				1							1								
Clytia	*linearis*	1			1		1	1			1	1		1	1	1				1	1	1	
Clytia	sp. 1					1																	
Clytia	sp. 2							1															
Clytia	sp. 3										1												
Clytia	sp. 4					1																	
Clytia	indet.	1		1	1	1	1	1		1	1	1	1	1			1	1	1			1	
Cordylophora	sp.	1																					
Corydendrium	*corrugatum*					1								1									

Appendix 2 (Con'td)

Genera	*species* / stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28
Corydendrium	sp.							1												1			
Coryne	*nipponica*												1										
Distichopora	*violacea*	1															1	1			1		
Dynamena	*cornicina*				1				1														
Dynamena	*crisioides*			1		1	1	1			1		1	1		1	1	1		1	1	1	
Dynamena	*moluccana*			1			1	1		1	1	1	1		1					1	1	1	1
Dynamena	sp. 1															1							
Dynamena	sp. 2												1										
Ectopleura	*viridis*										1										1		
Eudendrium	*racemosum*	1			1							1		1	1	1	1			1			
Eudendrium	sp. 1	1									1												
Eudendrium	sp. 2	1			1	1		1	1		1	1		1	1								
Eudendrium	sp. 3	1			1	1																	
Eudendrium	sp. 4				1																		
Eudendrium	sp. 5						1	1		1		1											
Eudendrium	sp. 6																			1		1	
Eudendrium	indet.												1								1	1	
Filellum	sp.				1		1	1				1						1				1	
Gymnangium	*?eximium*							1			1	1			1					1		1	
Gymnangium	*hians*			1		1	1	1	1	1	1	1			1			1		1	1	1	
Gymnangium	*hornelli*					1											1						
Gymnangium	*gracilicaule*				1											1							
Gymnangium	*?gracilicaule*	1						1															
Halecium	sp. 1	1																					
Halecium	sp. 2			1	1			1															
Halecium	sp. 3			1																			
Halecium	sp. 4				1																		

Appendix 2 (Con'td)

Genera	*species* / stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28
Halecium	sp. 5																	1					
Halecium	sp. 6										1		1										
Halecium	indet.							1															
Halopteris	*platygonotheca*										1	1			1	1	1	1					
Halopteris	sp. 1	1		1		1						1			1		1			1			1
Halopteris	sp. 2	1		1		1		1			1												
Halopteris	sp. 3				1			1				1											
Halopteris	sp. 4					1	1				1												
Halopteris	sp. 5										1												
Halopteris	indet.										1			1	1	1		1		1		1	1
Hebella	*furax*											1	1	1									
Hebella	*laterocaudata*														1								
Hebella	*muscensis*				1			1							1								
Hebella	*scandens*							1	1	1	1		1							1			
Hebella	sp.	1								1												1	
Hydraire	indet.			1																			
Hydrodendron	*gardineri*							1															
Hydrodendron	sp.							1															
Idiellana	*pristis*				1																		
Lafoeina	*amirantensis*																				1		
Leptothecate	indet.				1	1			1					1	1								
Lytocarpia	*brevirostris*	1						1		1		1		1	1			1				1	
Lytocarpia	*delicatula*													1									
Lytocarpia	*phyteuma*				1			1		1						1		1				1	
Macrorhynchia	*spectabilis*										1	1		1	1	1	1		1			1	
Macrorhynchia	*singularis*					1																	
Macrorhynchia	*philippina*						1							1		1					1		

Appendix 2 (Con’td)

Genera	*species* / stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28
Macrorhynchia	*?philippina*									1													
Macrorhynchia	*phoenicea*									1	1	1	1	1	1	1							
Macrorhynchia	indet.											1											
Millepora	*?platyphylla*													1									
Monostaechas	*quadridens*							1														1	
Nemalecium	*lighti*					1	1				1	1			1	1	1	1		1			1
Nemalecium	sp. 1	1		1		1	1	1	1		1	1		1	1		1	1				1	1
Nemalecium	sp. 2			1																			
Obelia	*dichotoma*					1																	
?Pachycordyle	sp.														1								
Pennaria	*disticha*	1		1	1	1	1	1						1	1	1				1	1		
Plumularia	*spiralis*						1							1	1	1	1				1		
Plumularia	group *setacea*	1			1						1		1	1						1		1	
Plumularia	*strictocarpa*					1			1														
Plumularia	sp.						1									1				1			
Plumularide	indet.									1													
?Proboscidactyla	sp.														1								
Rhizogeton	sp.	1		1									1				1						1
Salacia	*desmoides*								1														
Salacia	*tetracythara*							1															
Sertularella	*delicata*			1	1	1	1	1	1	1		1		1	1	1	1	1		1	1		1
Sertularella	*robusta*	1								1												1	
Sertularella	sp. 1											1											
Sertularella	sp. 2								1														
Sertularia	*maldivensis*												1										
Sertularia	sp.																						1
Sphaerocoryne	*bedoti*													1									

Appendix 2 (Con'td)

Genera	*species* / stations	1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	23	24	25	27	28
Stylaster	*roseus*																	1		1	1		
Synthecium	*?orthogonium*				1		1	1			1												
Synthecium	*flabellum*						1							1									
Synthecium	*patulum*			1	1	1		1	1		1		1	1	1	1		1	1			1	
Synthecium	sp.																		1				
Thyroscyphus	*fruticosus*				1	1	1	1		1	1	1		1	1	1	1			1	1	1	1
Tubularide	indet											1			1								
Turritopsis	*chevalense*	1								1	1	1		1		1				1			
Turritopsis	sp.				1	1																	
Zanclea	sp. 1	1		1		1										1							
Zanclea	sp. 2				1	1																	
Zanclea	sp. 3																	1					
Zanclea	sp. 4											1											
Zygophylax	*rufa*									1		1		1						1		1	
Total	(121 records*)	25	0	18	27	26	19	33	14	17	28	27	16	27	27	21	15	17	6	22	14	25	10

* Six of the unidentified records listed above need additional taxonomic studies to be assigned to the species listed in Appendix 1.

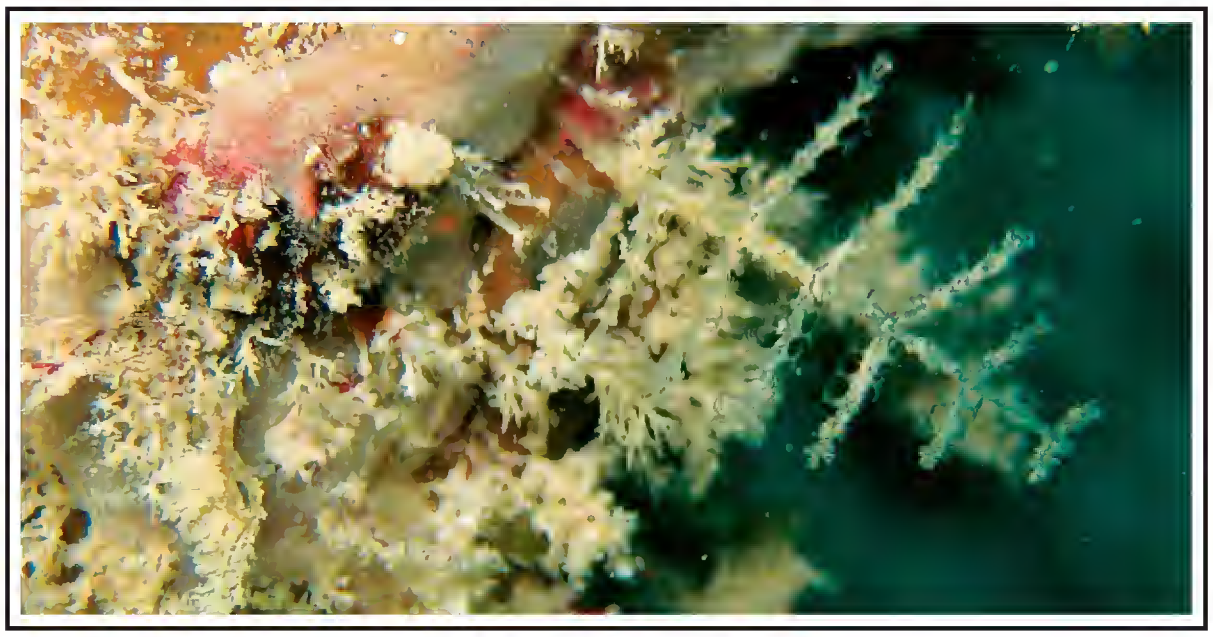
Appendix 3. Plates with in situ and underwater photographs.

Underwater Baa atoll landscapes with hydroids at different scales

Plumes of *Lytocarpia brevirostris* among other sessile organisms

Turf of *Halopteris* sp. among small actinians

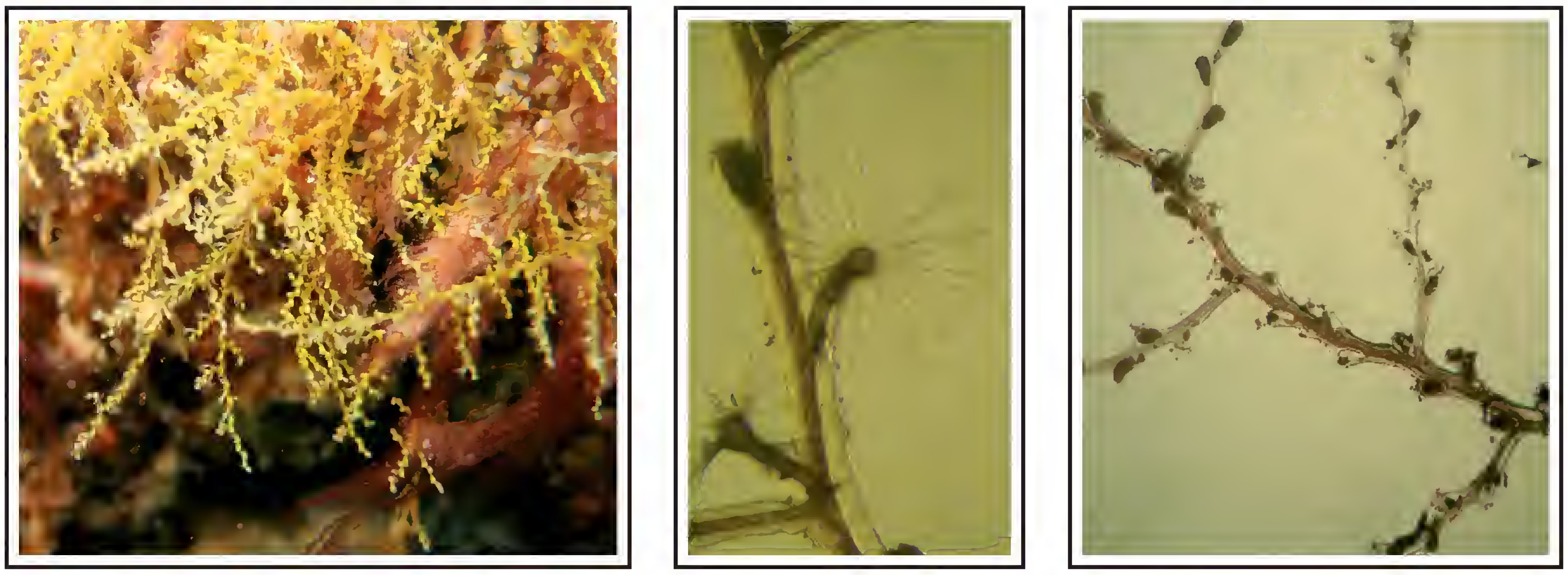
Leptothecates: protected polyps retractable into skeletal chambers (hydrothecae) provided or not with an operculum



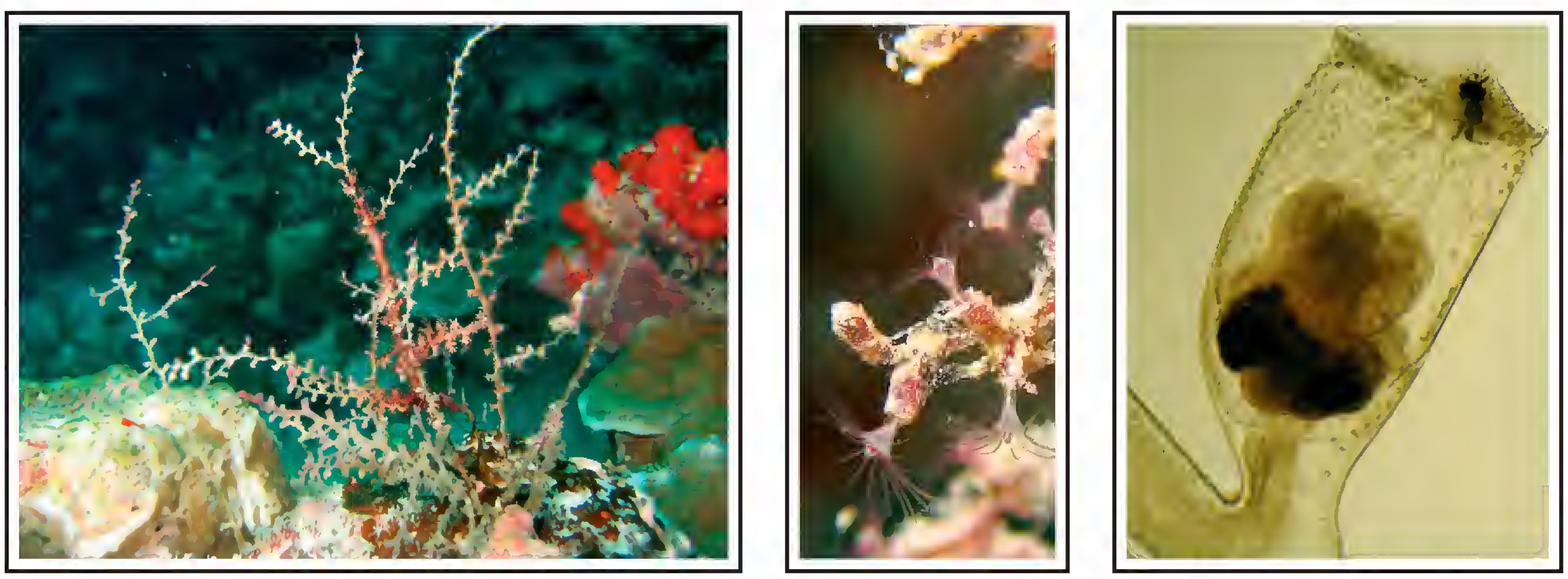

Synthecium patulum (Syntheciidae) has the characteristic opposite branches of the family with un-operculated hydrothecae in pairs. Its tissues are colorless conversely to other species (see below).


Dynamena crisioides (Sertulariidae) forms either small or large colonies in a plane (up to 4 or 10 cm for var. *gigantea* like here), the zig-zag shape of the stem being only visible on the top for larges. Its light yellow color can be hidden by particulate matter and organisms settled on the skeleton.

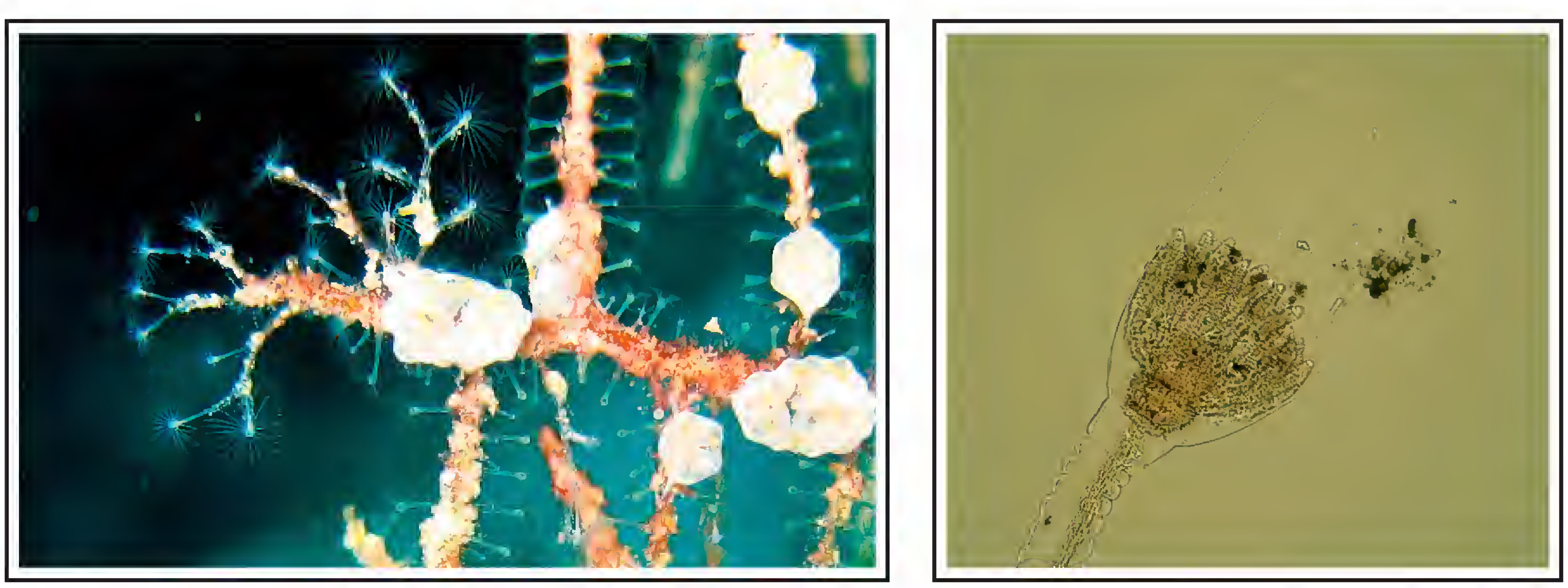

Dynamena moluccana (Sertulariidae) forms yellow pinnate and flexuous colonies that have been encountered in about each dive in Baa. Under currents, contrary of most of the sertularid species (see *D. crisioides*), branches are characteristically able to pivot on themselves (see varied positions here).



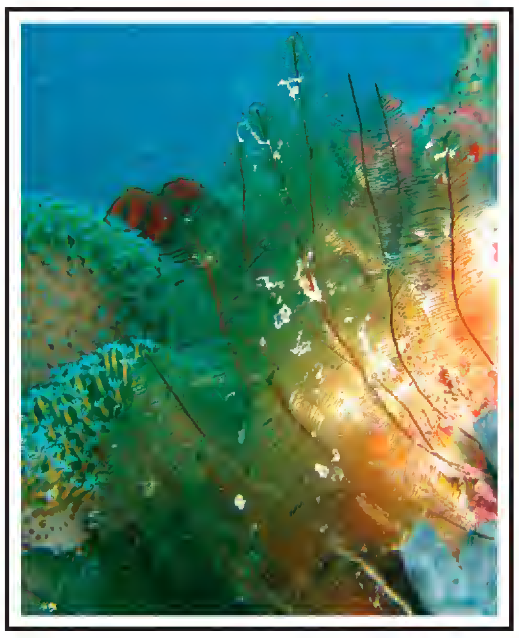
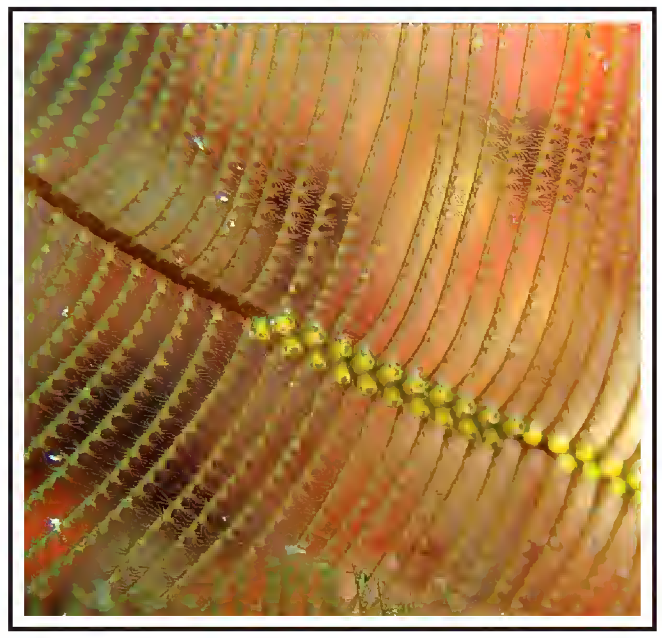
Sertularella delicata (Sertulariidae) exhibit typical bright yellow lace colonies. Large polyps inhabit short hydrothecae alternating on the branches, and closed by a four valves operculum. A circle of filiform tentacles surrounds the polyp mouth.



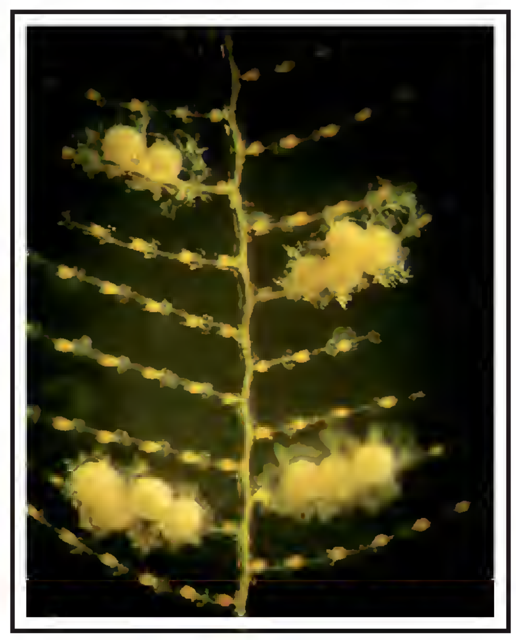
Thyroscyphus fruticosus (Thyroscyphidae) characterizes tropical intertidal and shallow waters of the Indian Ocean coral reefs. It is easy to recognize with its bright pink color associated to large pedunculated hydrothecae. The transparent skeleton takes usually a pink color as well, due to encrusting calcareous algae all around its surface.



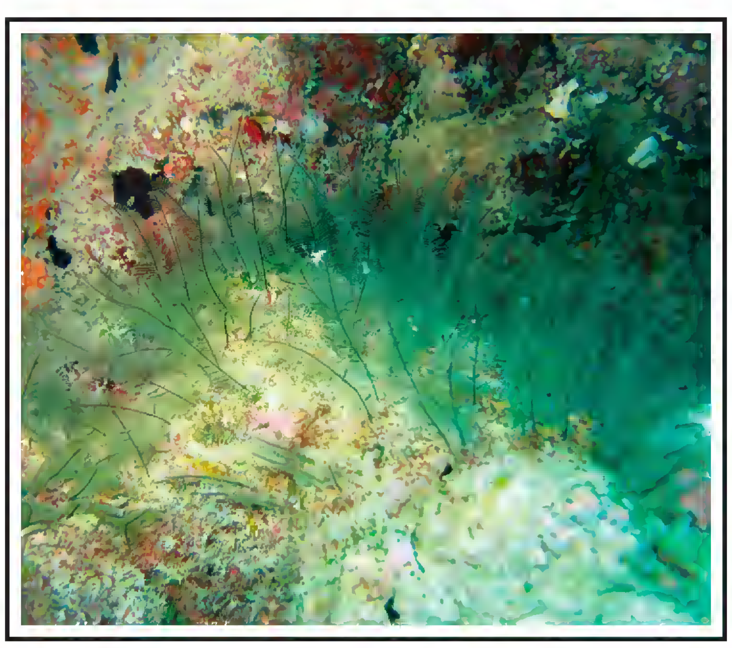
Clytia linearis (Campanulariidae) is a branched species with white polyps, settled here on the top of *D. crisioides* colonized by red cyanophytes and compound ascidians. This ubiquitous species was found on varied substrata and depths. Longitudinal lines visible at the surface of the hydrotheca gave it its name, whereas the margin teeth are not easily seen.


Gymnangium hians (Aglaopheniidae) exhibits feather-shaped rigid and thick colonies variable in color (green to brown), and grows in clumps. Hydrothecae have no operculum and are arranged unilaterally in files along the hydrocladial tube, like for all species of the family. Hydrothecae are shared by an intrathecal septum underneath the polyp retracts. See rounded reproductive features on the stem (gonothecae).

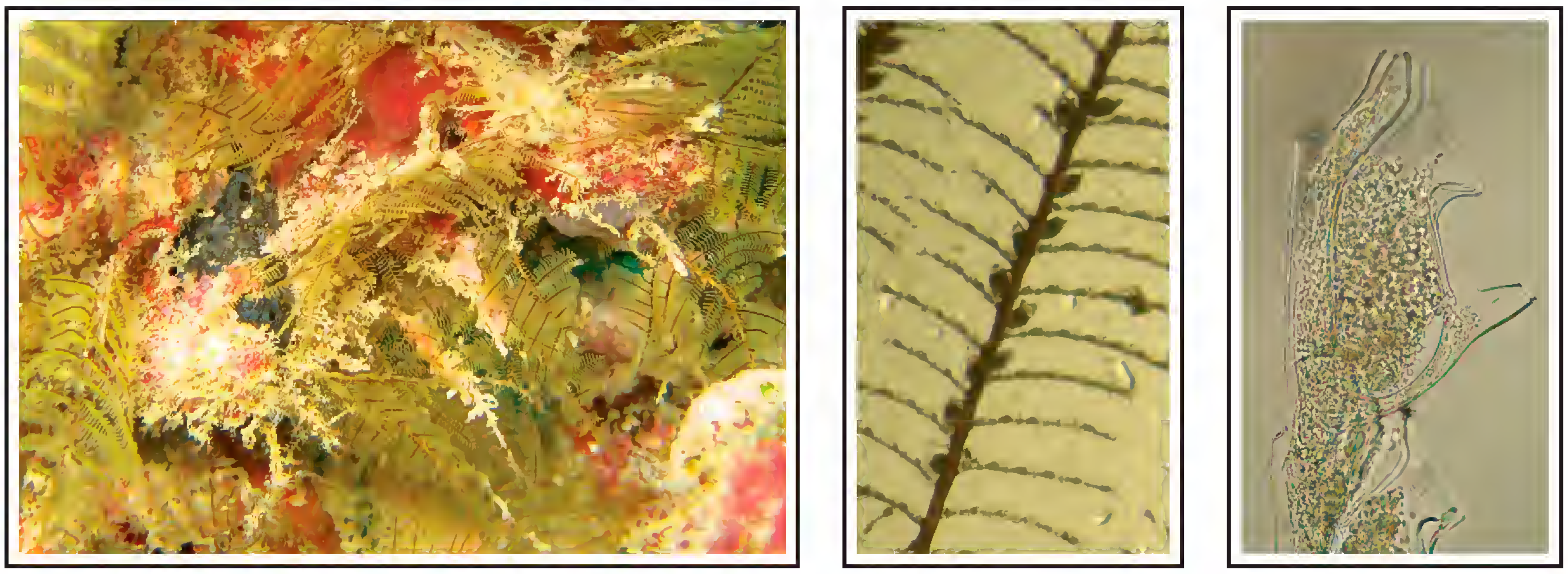




Lytocarpia brevirostris (Aglaopheniidae) has graceful pinnate colonies strictly in a plane, with an uniform light brown-orange color. When fertile, like in the pictures, they bear small oval reproductive features (corbulae) where larvae are brooded. The hydrothecae are curved with an aperture lined by lateral teeth plus one median.

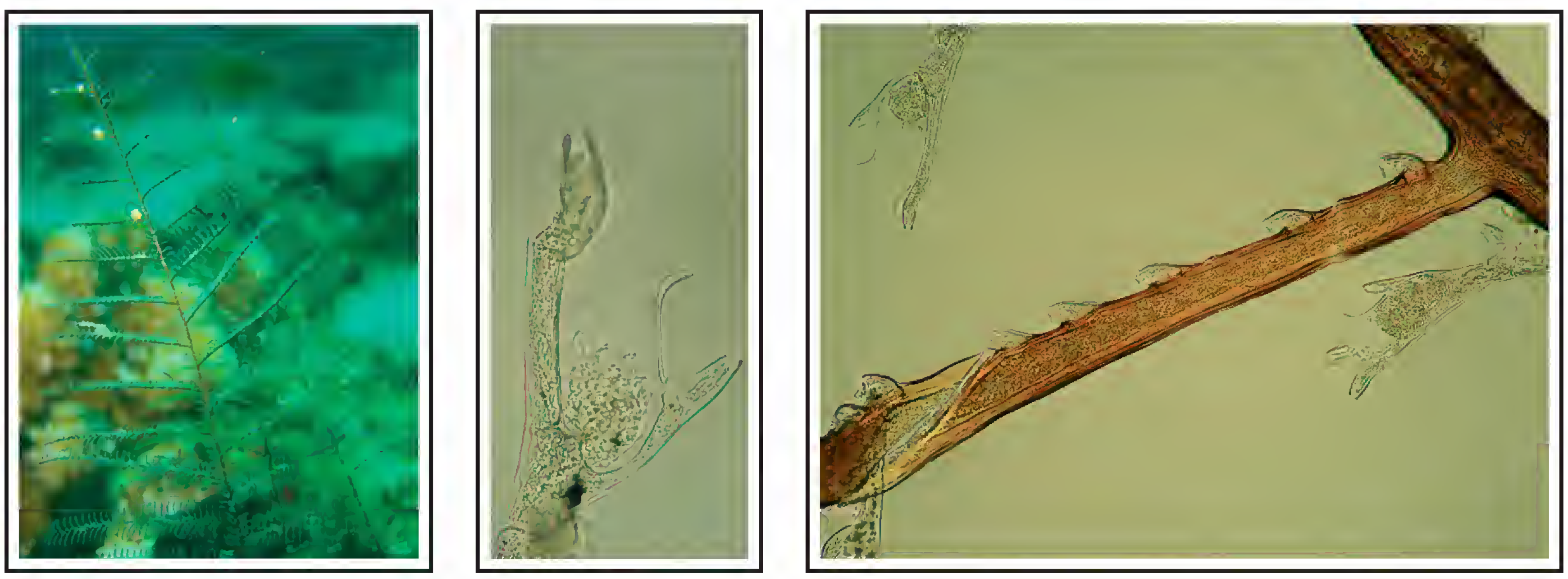


Lytocarpia phyteuma (Aglaopheniidae) is feather-shaped. It exhibits very long corbulae when fertile. Hydrocladiae are clear in color whereas the thick stem is often striated of brown and beige. The hydrotheca has regular lateral teeth plus one median, and a lateral skeletal thickening that seems to separate it in two chambers.

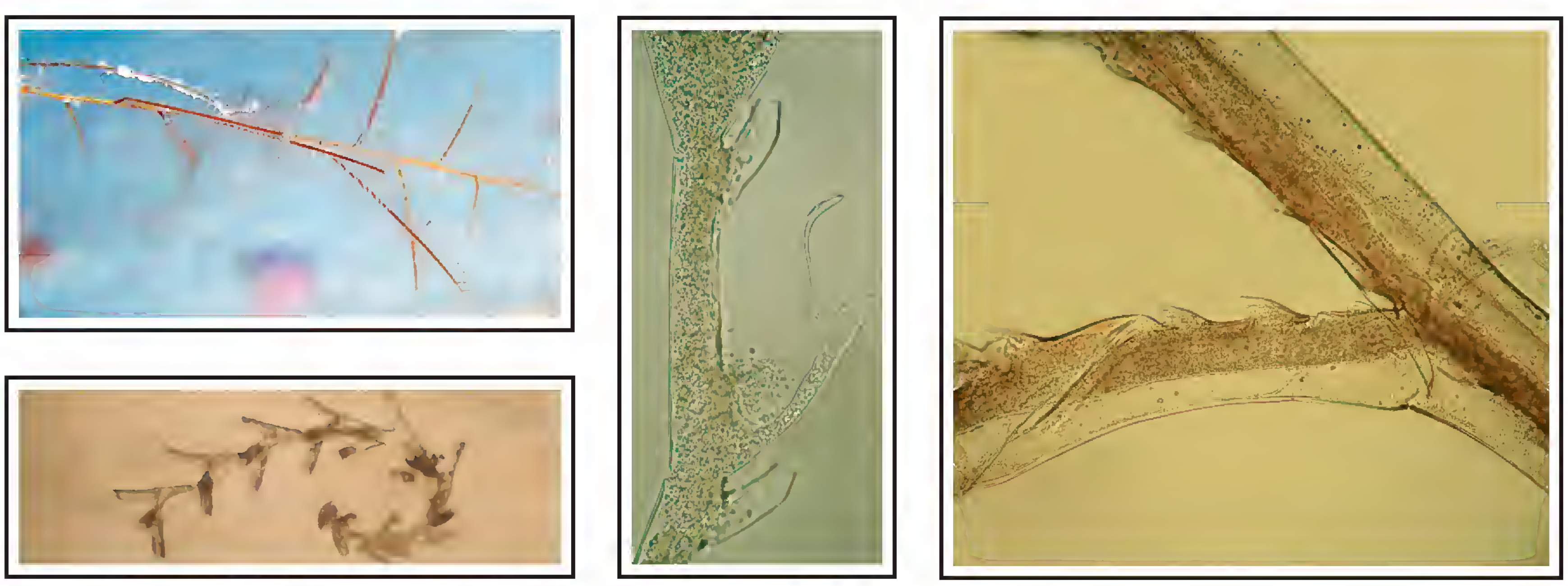
Other Baa atoll macroscopic hydroid species of the Aglaopheniidae family



Gymnangium eximium forms colonies with stem and branches strictly in a plane. Its color is yellow-green except for brown stems and branches. The even aperture and the shape of the hydrotheca are very similar to *G. gracilicaule* and *G. hornelli* below, but a small thickening of the skeleton is present at the curving**.**



Gymnangium gracilicaule exhibits slender colonies in a plane. Branches are connected with the stem by a long apophysis that ends by an oblique joint. As a consequence, they take a characteristic position, perpendicular to the plane of the colony, by rotating around the joint like for *D. moluccana* hydrocladiae.



Gymnangium hornelli shows long and flexuous colonies with branches inserted in a spiral (not in a plane) and delicate modified hydrocladiae (with nematothecae) surrounding the stem, a feature that allows identification. It has a strong oblique joint on a shorter apophysis than *G. gracilicaule*, and more elongated hydrothecae.



Macrorhynchia philippina is a stinging species having large and very flexuous colonies that branch up to three times. Inside the hydrotheca, the septum, linked to a small median tooth, appears triangular in profile view, not like a plate as in *M. phoenicea*. There is only one low lateral tooth on each side of the aperture.



Macrorhynchia singularis colonies are ramified in a plane and entirely brown, with a lot of characteristic white dots related to one big median nematotheca encountered besides some hydrothecae, a microscopic character allowing species identification.

Other Baa atoll macroscopic hydroid species

Anthoathecates (rare species)

Turritopsis chevalense (Oceaniidae) grows in clumps of large polyps bearing scattered filiform tentacles on the body column and exhibiting varied colors (white, yellow). This species reproduces by the means of medusae.

Nemalecium lighti (Haleciidae) is common species on coral reefs, forming nice colonies with bright white-blue flexuous polyps able to bend in all directions.

Zygophylax rufa (Lafoeidae) is characterized by its dark red rigid colonies in a plane, with sub-opposite branches. Particulate matter usually covers the skeleton.

Synthecium ?orthogonium (Syntheciidae) differs of the two other Synthecium species notably by its dark red color. Notice expanded hydranths on right and the branched bryozoan in the center.

Synthecium flabellum (Syntheciidae) develops large colonies strictly in a plane with opposite branches. The living tissues are very dark, about black.

Plumularia spiralis (Plumulariidae) is strongly recognizable from its black thin stems and branches of equal diameter, and from the spirally branching of the colony.